An ellipse may be drawn by the intersection of lines, as shown in Fig. 7. Draw A B, and bisect it at right angles with C D. With the point of intersection K as a centre, and with one half of the longer diameter of the required figure for a radius, strike the circle A C B D. From the same centre, and with one half of the shorter diameter for a radius, strike the circle E F G H. Divide each of these circles into the same number of equal parts, as shown by the small figures. From the several points in the outer circle drop lines vertically, and from the points in the inner circle draw lines horizontally, intersecting each other as shown. A line traced through these points of intersection will form an ellipse.

The Sectorian System of Hand-Railing.

THIRD PAPER.

On plate 18 are four examples of plans, varying in size from six to twelve-inch cylinders, or from centre to centre of rail on each side of cylinder, with their wreaths drawn from tangents taken from the sector, with spring and plumb bevels to each.

In every case these bevels are the same, when the pitch-board is the same for different flights. No. 5 is a plan of a winding stairs, with cylinder twenty-four inches. This plan is in very common use, hence the need of giving an example on this system, showing the simplicity to which the whole subject is brought. For instance, required the wreath for a circular stairs, the cylinder being two feet, and eight winders in the semicircle. Suppose the space to be eight feet wide, having three feet length of tread on each side of cylinder. First draw the chord line and get the centre; draw the semicircle of rail, which will be twenty-four and a half inches to centres; next draw tangents, as at No. 5, cutting centre of rail at right angles on each side; then, from the centre of chord line A, draw lines cutting through angle of tangents E and C; then draw through back of cylinder at a right angle with chord line. These lines give the face of the risers of four winders in the cylinder. Now divide the spaces, and draw as before, and you have all the winders. Now unfold the sector to a level plane—cover the face with white paper pinned on at the four corners; draw a base line across the face; then on this line set off from the joint, each way, the distance from D to E (Fig. 5), and from E to F—E being the joint, raise lines from those points, D and F. Now get the height of four risers, which in this case is twenty-eight inches, and half of the wreath; now draw the angle across the face of the sector from D to E (No. 5). Now fold the sector to a right angle, and secure it in that position by the wire brace across the top end; now turn the sector and let it rest on its two edges, with the angle upwards; now apply the tangent bevel across the angle, with each blade ranging with angle line of the rake of the winders, which give the tangent as at A, B, C, No. 6.

The length from A to B, No. 6, is the height from D to E, No. 5, on the rake line. While the tangent bevel is in position across the sector, take the spring and plumb bevel and apply one blade on the face of the sector, and the other against and at right angles with the blade of the tangent bevel: this gives the spring and plumb bevel, which in this case is the same, and gives the twist of the wreath from A to C, No. 6.

After the length of the tangents, A, B, C, are procured, as shown by dotted lines, draw down at right angles with tangent lines on each side, also plumb line from B to D, intersecting at D, from which point describe the wreath from A to C. If the piece is too long for the dividers, stick a pin at A and C; then take a bevel with each leg as long as wreath piece, with inner edges straight; then from the chord line A, C at the centre, set up the distance from H to I, No. 5. At this point place the angle of the bevel, each leg touching the pins inside and with pencil in the angle, and pressing the legs against the pins, describe the piece from A to C.

The spring and plumb bevels give the convex and concave twist, to which apply the falling moulds on both sides, which in this case is the width of the thickness of the rail, and perfectly straight. The spring and plumb bevel having given the horizontal line at each section of wreath, the centre of the moulds must be placed at these centres and drawn close to the surface and pinned. Tin is best for these moulds, as the best preventive from kerfing too deep, as might be the case if pasteboard be used. After kerfing, remove moulds, and work off to lines, and you have top and bottom face of rail. The same face and falling moulds will answer for both pieces of wreath, as they are both the same shape.

In these notes I have endeavored to be as plain as possible, so that none may complain of abstruse technicalities.

Isometric Projection.

To make the "scale of tangents" as shown in Fig. 8, plate 15, proceed as follows: Let *a b c d* be the side of a square. From *a*, with radius *a b*, describe the arc *b c*. Divide this into nine equal parts, and through these draw, from the point *a*, lines cutting the sides *c d*, *d b*. Divide each of these parts into two equal divisions, and draw lines as before. The line *b d* will form a "scale of tangents to 45°," ending at the point *d* at 45°. Next construct an isometrical cube, as

in Fig. 7, plate 15, of which the side A B will be an *isometrical proportion* to the side *a b* of the square in Fig. 8. Produce the lines *c g, g e,* Fig. 7, as *g i g h*. Parallel to the side *e f*, Fig. 7, set off the distances *b* 10, *b* 20, *b* 30, *b* 40, taken from the line *b d*, Fig. 8, and from these points on the line *h i*, Fig. 7, draw lines to the point *g*, cutting the line *e f* as shown. A "scale of tangents" to 45° will thus be formed on the line *e f* of the cube. The divisions denoting the 5th, 15th, 25th, 35th angles on the line *b d*, Fig. 8, may also in like manner be transferred to *e f*, Fig. 7. These divisions may then be transferred to the other sides of the cubes, *a g, a b*, and so on, till all the sides are formed into scales of tangents, each of which may be applied two ways, or twenty-four ways in all. The square *a e f g*, Fig. 8, is a square equal in dimensions to that A *b c d* in Fig. 3, plate 15. The reader will at once see the applicability of these lines to the cutting of the cube in a great many directions. Figs. 8, 9, 11, and 13 will fully explain themselves, and indicate the way in which angular surfaces may be delineated.

The method by which circles are described isometrically now claims our attention. Let *a b c d*, Fig. 9, be the circle of which an isometrical projection is desired, and of which *e* is the centre. About this circle describe the square *f g h i*. Next project a cube, of which the side *a b*, Fig. 9, is in isometrical proportion to the line *h i*, Fig. 12. In the upper face of cube, *a b c h*, Fig. 12, draw the diagonals *a b c d*, cutting each other in the point *e*. Make *e f, e g* equal to the diameter *e c*, of the circle in Fig. 9. From *f* and *g* draw lines parallel to *a b c d*, cutting the sides *d a, a b, b c, c d*, in the points *n, l m*, and *k*. Eight points, *n, h, L, F, M, I, K*, and *G*, are thus obtained, through which, by hand, the ellipse or oval may be drawn. If the representation of a cylinder is required, the same process must be repeated in the lower side of cube *o p q c*, so as to obtain the part of the circle equal to the part *g k i m* and *f* of the upper circle; the cylinder is completed by drawing the lines *f s g r* parallel to *b g d o*. Fig. 11 shows a circle projected in the left hand, and Fig. 10, in the right hand plane or side of a cube.

Correspondence.

We invite communications from our readers in matters connected with the trades we represent. Be brief, courteous, and to the point.

Editor of Wood-Worker:

I am well pleased with the Illustrated Wood-Worker, and like the style of its "get up;" the plates and typography are excellent, and, like the *American Builder*, shows the handiwork of good mechanics; and the subject-matter is well selected and plainly treated, so that every one may understand, which is proof sufficient that there is a master-hand in the editorial department—one who knows the wants and tastes of the wood-workers in general.

The papers on "Practical Carpentry" are quite scientific and good. I hope they may be continued to the end. It is just what all carpenters need, old or young, who have any ambition to become master mechanics or useful in their profession.

I would like to make a few suggestions.

To be brief: First, then, I think there should be a scale of feet and inches accompanying each plate, elevation, plan, or other drawing. A plan or elevation may look well on paper and please the eye, yet a mechanic undertaking to execute the plan may get the book-case, or house, or whatever it may be, badly out of proportion, in the absence of any scale to work by. Industrious and ambitious apprentices and young mechanics are often found building book-cases, wardrobes, tool-chests, and miniature houses, etc., during the winter, or other slack times, and I may say the "old mechanic" as well.

Secondly. On page 5, plate 3, Illustrated Wood-Worker, I find the ground plan of the writing-table exactly reversed to what I think it should be. The *front* of the *ground plan* is lying to the front of the writing-table, and is best understood by turning the book upside down, then the writing-table is also upside down, which causes a confusion of ideas.

I have noticed the same thing in the elevations and plans of houses. Now, I think, where the front elevation with the ground plan are given, to be plainly seen and fully understood the elevation should be first on the page or drawing, directly opposite the beholder, then the ground plan below or between the person viewing it and the elevation, and the front of the ground plan next to said person, as then there would not be any confusion, caused by the frequent reversing of the drawing, to thoroughly and intelligently read the plans, etc.

I know there are times and cases where this cannot be done, on account of room or position of building.

By placing the drawings in the position suggested, many of your readers will be benefited, and much trouble and bewilderment will be avoided. J. A. K.

Petaluma, Cal., Feb. 3, 1879.

Editor of the Illustrated Wood-Worker:

I forward you a few drawings which I think may be of service to some of your young readers. Figs. 2 and 3, plate 23, show easy methods of constructing octagons. Lay the